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ABSTRACT

This paper examines the value conflicts engendered by computing developments in two different institutional settings: electronic funds transfer systems and instructional computing in primary and secondary schools. While specific values depend upon culture and upon the character of the particular institutional setting studied, these two cases serve as instructive points of departure for examining the value conflicts that generally accompany different modes of computerization in other developed and developing countries. In particular, computing developments in Brazil illustrate some of the parallels and contrasts between developed and developing countries. (Author/TE)

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Value conflicts in computing developments

Developed and developing countries

Rob Kling

The author examines the value conflicts engendered by computing developments in two different institutional settings: electronic funds transfer systems and instructional computing in primary and secondary schools. While specific values depend upon culture and upon the character of the particular institutional setting studied, these two cases can serve as instructive points of departure for examining the value conflicts which generally accompany different modes of computerization in other developed and developing countries. In particular, computing developments in Brazil illustrate some of the parallels and contrasts between developed and developing countries.

Keywords: Computer communications; EFTS; Education

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Computing developments, like other social, economic and technical developments, are not socially neutral. Different ways of organizing control over computing resources (such as data, machinery, communications, expertise, and administrative procedures) have an associated politics.[1] The political commitments that accompany computing developments are comprised by, in part, the way in which the equipment and support staff add to or subtract from other forms of social investment, and foster dependencies on external vendors, technical labour markets, etc.[2] The political dimensions of computing development also hinge importantly on the kinds of social arrangements which accompany specific kinds of applications, eg the ways in which data subjects' privacy is affected by the collection of data about themselves,[3] the extent to which clients of computer data systems are buffered from input or programming errors,[4] and the extent to which the distribution of computing resources exacerbates social inequities.[5]

These political characteristics of computing are often subtle, particularly with respect to newer and more fragmented computer-based technologies. Systematic patterns are most visible when many cases are examined, and when interest groups have articulated their preferences. Thus, special insight can be gained by examining the deployment of the 'moderately developed' computing technologies in which value conflicts are most dramatic. This observation may pose some problems for comparing computing developments cross-nationally, since the kind of computing development most often undertaken, as well as the depth of pertinent social conflict, may vary cross-nationally.

This article examines one political dimension of new computing developments – the value conflicts that they help catalyse. It examines conflicts of social values that are specially important in the deployment of two very different kinds of computing technologies in the USA – electronic funds transfer (EFT) systems and instructional computing in primary and secondary schools.

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While many studies of international development call special attention to the social and political dimensions of technical development, most of the literature on 'computing in developing countries' is apolitical[6] and value-laden. In particular, most authors assume that rapid computing development is socially progressive, while ignoring large inequities in the distribution of wealth in developing countries. These analyses of computing developments or 'policy options' addressed to problems of developing countries are consistent with the larger tradition of commentary about the social dimensions of computing in industrialized countries, commentary which also pays little attention to the politics of computing developments.

Commonly, such commentaries contain futuristic and naïve scenarios in which all (significant) members of a society have access to computer-based information services and 'personal' computer systems.[7] Such views assume that there are no significantly scarce resources in the societies they describe – no poor, no infirm, no ill-educated, no socially stigmatized. These assumptions are unrealistic even for developed countries like the USA, Japan, and the countries of Western Europe. In short, much of the literature on new computing developments rests on an implicit utopian vision of ample social resources; all (industrialized) societies appear relatively underdeveloped in comparison with these 'computopias'. As a consequence, it is difficult to examine directly the political dimensions of the evolution of computing in developing countries by investigating the literature on future computing developments in general.

This article provides an alternative by focusing on value conflicts which are catalysed by current computing developments in the USA. While values are inherently bound up with a particular cultural and historical period, the kinds of conflicts examined here help shed light on analogous conflicts in other developed and developing countries.

Computers as causal agents

Before examining the ways in which computerized systems are catalysts for conflicts among social values, their roles as instruments of social action should be clarified. Computerized systems are usually portrayed as powerful actors at one extreme or as mere tools at the other. Large-scale computerized systems are probably better viewed as institutions with ecologies of social and political support that render them most responsive to particular elites and to the staff which develop, market, implement and operate them.[8] Even when seen as instruments, however, computer-based systems are complex relative to what the tool analogy leads one to expect.

Personal knowledge of computing

Our picture of computerized systems is predicated on and amplified by scattered news stories and gossip. We are led to entertain hastily formed beliefs concerning what computerized systems are good for, how they work, how and when they fail, and what interests they serve. Yet, although many people interact with computers frequently, few can claim direct experience with and knowledge of the full array of computing developments. There are so many different modalities of computing adapted to so many different social worlds that intimate knowledge of the

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Resources Policy. The views represented here are not necessarily those of either the National Science Foundation or the Harvard Program.

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[1]James Danziger, William Dutton, Rob Kling and Kenneth Kraemer, *Computers and Politics: High Technology in American Local Government*, Columbia University Press, New York, 1982.

[2]Rob Kling and Elihu Gerson, 'The social dynamics of technical innovation in the computing world', *Symbolic Interaction*, Vol 1, No 2, December 1977.

[3]James Rule, Douglas McAdams, Linda Stearns and David Uglow, *The Politics of Privacy*, New American Library, New York, 1980.

[4]Theodore Sterling, 'Consumer difficulties with computerized transactions: an empirical investigation', *Communications of the ACM*, Vol 22, No 5, May 1979, pp 283–289.

[5]John King, Rob Kling and Kenneth Kraemer, 'Maintaining social equity in EFT developments', *Proceedings of the 3rd International Conference on Information Systems*, Ann Arbor, Michigan, 1982.

[6]Kalman provides a good example of the dominant apolitical literature (Robert Kalman, 'Eight strategic issues for informatics', in J.M. Bennett and R.E. Kalman, *Computers in Developing Nations*, North Holland, New York, 1981). Prieto-Diaz and Wilson provide a politically sensitive alternative, rare in its examination both of the *costs* of computing support and of the *employment impacts* of computing (Ruben Prieto-Diaz and Stephen Wilson, 'The impacts of computing on the Latin American countries', *Computers and Society*, Vol 11, No 2, Spring 1981, pp 2–9).

[7]Christopher Evans, *The Micro Millenium*, Simon Schuster, New York, 1979; James Martin, *The Telemic Society*, Prentice Hall, New York, 1981.

[8]Rob Kling, 'Defining the boundaries of computing in complex organisations', Working Paper, Public Policy Research Organization, University of California Irvine, Irvine, CA, 1982.

complete world of computing is simply unobtainable even for computer experts.

Consider a technologist who specializes in electronic mail systems – one of several technologies which comprise contemporary office automation. He has accumulated detailed information about which mail systems have good facilities for saving and editing mail. He knows about the costs for preparing, sending and saving messages on various electronic mail systems. Developing this expertise takes attention and time. While he is a specialist in electronic mail he is often almost like a layman in understanding other computer-based technologies such as urban information systems,[9] artificial intelligence, military command and control systems, or EFT.[10] Each major class of computing applications rests on somewhat different technologies in different social and economic arrangements.

The modes of computing currently in use are extremely diverse. Furthermore, many computing technologies are not merely gadgets built of hardware and software and placed in social settings, but are the focus of technology-based social movements. These computer-based social movements include:

- Computer assisted instruction.
- Personal computing.
- Office automation.
- Urban information systems.
- Medical information systems.
- Simulation/gaming.
- Material requirements planning (manufacturing inventory control).
- Electronic funds transfer (EFT) systems.
- Artificial intelligence.

The preceding list of the uses of computer technologies hardly exhausts the different modes which are being developed and implemented today. There is no 'automated payroll movement', but thousands of organizations have automated their payroll preparation. Other modes of computer use, such as complex statistical analyses in the social sciences or numerical analysis in the physical sciences, are simply part of a larger scientific movement, a movement which emphasizes quantification of research strategies and the use of computing when the number of samples and variables becomes large. Even the simplest labels, such as 'personal computing' or 'medical information systems', allude to whole families of computer applications. Each of these families, in turn, may have many specialized variants in use in many different organizations or social settings.

Storylines

One way to make sense of this bewildering array of computerized technologies is to adopt a simple 'storyline' about computing, which orders this chaos. Three common storylines are:

The cavalcade of progress. 'Computers enable people to communicate and compute in ways heretofore impossible. They increase people's efficiency, while reducing the costs associated with people's execution of particular tasks'.[11]

Technology is dehumanizing and out of control. 'Computerized appli-

[9]Danziger, *et al*, *op cit*, Ref 1.
[10]Rob Kling, 'Value conflicts and social choice in electronic funds transfer system developments', *Communications of the ACM*, Vol 21, No 8, August 1978, pp 642–657.
[11]See, for example, Evans, *op cit*, Ref 7.

cations foster the depersonalization of services, bring with them new problems and inefficiencies, and are exploited by managers to control, de-skill, or eliminate workers' jobs'.[12]

Technology is neutral. Technologies do not have an intrinsic politics; they can be used for good or ill. If the 'interesting' versions are used 'properly', then they can enhance the quality of life in the societies that use them wisely. Much depends upon what society 'decides' to do with new technologies.[13]

These simplified storylines underlie many accounts of computing. They help simplify the buzzing confusion. Whether we favour one or another of these storylines, they all are simple to comprehend. They are also context-free; they can be applied to almost any computerized (or other) technology. Even if one does not understand how computer-based systems work, one can make sense of these themes. Each theme carries a grain of truth, but none are either proven or disproven by the examples usually proffered. Each storyline also carries moral weight with an implicit value stance about what is good or bad for people.[14]

Cognitive simplicity is the primary virtue of such storylines. None of us has the time to study each computer application we encounter in order to evaluate its particular merits and faults. But the storylines also suffer from a serious defect. They depend on two somewhat dubious assumptions: that computerized applications are independent forces which 'arrive' in an organization, and then must be reacted to; and, that computerized applications are value-free instruments with a uniform set of impacts which can be identified without reference to the social relations within and between groups that use them. These assumptions introduce significant biases and errors into many examinations of the impact of computerized applications.[15]

Computers as actors and instruments

Computers are often treated as powerful actors. Assertions such as 'computers increase productivity', 'computers dehumanize jobs', 'computers make learning exciting', 'computers improve decision making', and 'computers are revolutionizing American society', make computer systems into powerful social actors. At best, these claims are shorthand codings for extremely complex sets of events. Computers are not active independent forces, but are instrumentalities which have consequences under special and rather complex conditions.

The example of price scanners in North American supermarkets is illustrative. In some cases, the markets which adopt these computerized devices have laid off clerks or avoided hiring additional clerks in proportion as their business grew. But this is not a simple issue of 'computers *v* jobs' or 'computers eliminate jobs'. Such compact descriptions ignore the role of powerful actors, the supermarket owners and managers.

Storeowners hope to reduce costs by carefully replacing workers with capital equipment. Scanners do not show up unexpectedly in supermarkets like mushrooms sprouting on a lawn. Scanners are expensive and, hence, purposely planted. A pedestrian who is hit by a car doesn't say, 'This is simply a case of technology versus people'. He wants to know who was in the driver's seat. Compact slogans like 'technology *v* people' or 'computers cut jobs' imply that there is no one in the driver's seat.

The development of supermarket scanners involves important social

[12]Harry Braverman, *Labor and Monopoly Capital*, Monthly Review Press, New York, 1976.
[13]Anthony Smith, *Goodbye Gutenberg: The Newspaper Revolution of the 1980s*, Oxford University Press, New York, 1980.
[14]Kling, *op cit*, Ref 10.
[15]Kling, *op cit*, Ref 8.

choices about the organization of work which are obscured by emphasizing 'technology' and 'jobs' and neglecting significant social choices. Supermarket owners can deploy scanners at the check-out stand and have checkers use them with or without abandoning item-pricing. Market owners often claim that they must abandon item-pricing to save sufficient labour costs to make the scanners economically efficient. If that were the case, they could introduce scanners and raise their prices, or wait until scanners were cheaper.[16]

This example of supermarket scanners illustrates a common role played by computerized technologies as catalysts of social conflict. Market owners are said to be seeking ways to reduce costs. Computer systems might provide a useful means of doing so. When such systems are adopted, certain price-marking jobs will probably be eliminated. However, one by-product of eliminating these jobs is to reduce the job market for women and part-time workers. It also reduces the ability of consumers to audit their purchases at the checkstand to be sure they are not being overcharged.

In such cases, it is facile to attribute the outcomes such as the removal of item pricing to computers. The computer is a critical instrument which enables supermarket owners to consider the feasibility of both removing item prices and reducing their direct labour costs. But to neglect the role of the supermarket owners or managers would be mistaken. It leaves no one in the driver's seat.

This example also illustrates another critical aspect of computing. Most people do not interact in simple ways with computers or computer applications. We confront computerized technologies embedded in relatively complex social orders.[17] In the case of supermarket scanners, a customer deals with the price-marking policy of the store, with a database of prices which is kept up-to-date by clerical staff, and with policies for having checkers rapidly scan the goods. The goods are managed by the floor supervisor, who can keep track of the productivity of each checker. A person who is at the receiving end of any of the socially important computer applications is inextricably bound up in the organizational world which it supports, whether the application by airline reservations, computer assisted instruction, long-distance dialling, the IRS tax auditing systems, or a police wants and warrants system. Dealing with computing entails dealing with the organizational arrangements which surround the technology.

Similarly, if computer applications are introduced to schools on a mass scale, they will be shaped by the organizational imperatives of public schooling. First, these applications will be integrated into curricula and become the subject of courses, syllabi and regular testing. Second, their deployment will be bound up with the political economy of schooling in general and the internal economies of the individual schools. Students in richer schools will fare better than those in poorer ones; those schools that can attract a cadre of talented and inspired teachers will offer their students more interesting and varied opportunities than schools where talent and inspiration married to instructional computers will be rare.[18] In these ways, computerization is no different from other interesting, but specialized, complex and relatively expensive resources,[19] except that many people with interesting ideas about how to use computers for children insist quite vehemently that computerized technologies have special properties as social resources.[20]

[16]The arguments advanced by market owners are difficult to evaluate because good data about the costs and pay offs of scanners are scarce.

[17]Kling, *op cit*, Ref 8.

[18]People with these talents are still uncommon, and have good occupational opportunities in private industry. In the next decade, at least, they will be difficult to attract to poorer or more troubled schools.

[19]The costs of computing are largely not those of the machinery, even though computers and terminals are relatively scarce in most schools. Software, operational support, and related curricular materials greatly increase the overall costs of mounting a rich computer-based curriculum.

[20]Seymour Pappert, *Mindstorms: Children, Computers and Powerful Ideas*, Basic Books, New York, 1980.

Conflicts of value and interest in computing

Computing developments cannot be assessed in isolation from the organizations or cultures that use them. Our example of price scanners also suggested that computers may catalyse conflicts between different groups that are impacted by their use.

Organizations can try to treat computer-based systems as instruments, and turn them to serve their interests. When groups conflict, one or more of them may find ways to exploit computerized technologies to their advantage. A group may exploit the symbolic dimensions of computerized data systems to gain legitimacy or to capture the substantive advantages of high speed communication and data manipulation.[21] In many cases where computer-based systems are exploited for relative advantage in inter-group conflict, there is conflict over resources and social terrain, but not over key social values. For example, if one department in an organization uses sophisticated breakdowns of its workload to argue for more staff during budget reviews, its managers need not differ significantly in value-orientation from those in other departments which are also competing for larger shares of the budgetary pie; all the managers may well want bigger and better-trained staffs.

On the other hand, some groups conflict in values, as well as in interests. The study of the dynamics of these kinds of groups is the subject of this inquiry. Value conflicts that are catalysed by computing developments in two domains of computer use, electronic funds transfer systems and instructional computing in secondary schools, are now examined. The specific values in each case derive from political debates within the USA. They will not apply in any straightforward way to developing countries. However, the ways in which groups which promote the deployment of new computing developments often serve some values at the expense of others is more universal. Also, many collateral social choices can be made in automating some activity. These include such matters as the particular form of technology employed, conditions under which different participants control data and associated computing resources, pricing policies, etc. Even when the equipment configurations are limited in variety, these collateral elements can vary significantly, and support or undermine specific social values.

Value conflicts in EFT developments in the USA[22]

EFT systems are composed of an array of different technologies which transfer funds electronically between accounts. They include networks for automatically clearing cheques while debiting and crediting accounts, directly debiting and crediting individual bank accounts from point-of-sale terminals in retail stores, and providing cash on demand 24 hours a day.

EFT systems represent a particularly rich source of illustrations of value conflicts because they have now been in use for a significant period of time, because their adoption and promotion involve substantial commitments on the part of the financial institutions that use them, and because their diffusion has affected a broad cross-section of the public at large. Conflicting storylines about EFT systems are readily apparent in both popular and academic literatures.

At one extreme, some analysts identify emerging EFT systems with social progress. For example, Long claims that:[23]

[21] Rob Kling, 'Social analysis of computing: theoretical orientations in recent empirical research', *Computing Surveys*, Vol 12, No 1, March 1980, pp 61–110; and Danziger, *et al*, *op cit*, Ref 1.

[22] This section and the next one draw upon more extensive analyses of EFT development (Kling, *op cit*, Ref 10).

[23] Robert Long, *EFT Systems, Banking and Regulation I*, American Bank Institute, 1974.

EFTS is happening because it is a better way. All arguments about the sufficiency of the present paper system are meaningless. Television did not come about because the radio system was overloaded or was breaking down, nor did radio or the telephone develop because the mail was about to collapse. Neither were these systems built because the public was crying for their development. They came about simply because they represented a 'better way' of communication.

Such proponents of EFT systems point to their ability to reduce the cost of paper processing, reduce petty theft and support convenient add-on services such as automatic payroll deposits. They have visions of a chequeless and cashless society, in which integrated EFT systems transfer money instantaneously and efficiently. While Long's remarks were published over eight years ago, the storyline is common today.

At the other extreme, many analysts and policy makers have pointed to major and unresolved social and technical problems associated with EFT developments. Maintaining consumer sovereignty in markets within which EFT services are provided, the development of reliable systems, and the protection of individual privacy have been among the issues engendering controversy and debate.[24] In fact, the diffusion of EFT applications has not yet delivered anticipated benefits fully in many instances; and, while EFT systems are widespread, they are for the most part operated without large-scale integration.

The importance of these issues, and the sense one makes of them, is inextricably linked to the value orientation of the analyst.[25] At this point, EFT developments have matured sufficiently that at least five distinct value orientations, each resting on its own assumptions about which social goods should be maximized, can be identified in policy debates in the USA:

Private enterprise model: The pre-eminent consideration is profitability of financial systems, with the highest social good being the profitability of both the firms providing and the firms utilizing the systems. Other social goods such as consumers' privacy or the need of the government for data are secondary.

Statist model: The strength and efficiency of government institutions is the highest goal. Government needs for access to personal data on citizens. The need for mechanisms to enforce citizens' obligations to the state will always prevail over other considerations.

Libertarian model: The civil liberties as specified by the US Bill of Rights are to be maximized in any social choice. Other social purposes such as profitability or welfare of the state would be sacrificed should they conflict with the prerogatives of the individual.

Neo-populist model: The practices of public agencies and private enterprises should be easily intelligible to ordinary citizens and be responsive to their needs. Societal institutions should emphasize serving the 'ordinary person'.

Systems model: Financial systems must be technically well organized, efficient, reliable, and aesthetically pleasing.

In different instances, policies and developments may support, conflict with, or be independent of these models. Each of them, except the

[24]Mark Budnitz, 'The impact of EFT on consumers: practical problems faced by consumers', *University of San Francisco Law Review*, Vol 13, No 2, Winter 1979, pp 361–404; and Rule, *et al*, *op cit*, Ref 3.

[25]Kling, *op cit*, Ref 10. For a general introduction to the 'value-conflict' approach, see Earl Rubington and Martin Weinberg, eds, *The Study of Social Problems: Five Perspectives*, Oxford University Press, New York, 1981, Chap 4.

Systems model, has a large number of supporters and a long tradition of support within the USA. Thus, EFT developments which are congruent with any of these positions might be argued to be in 'the public interest'. These value positions are not all comparably developed in other countries, as we shall see in the discussion of computing development in a developing country, Brazil.

Perceptions of benefits and problems depend upon one's values and commitments. To illustrate this point, I will examine some of the meanings and conclusions each perspective generates when brought to bear on some specific areas of controversy: market arrangements, consumer protection, and the privacy of personal financial transactions.

Market arrangements

According to advocates of *laissez-faire* markets, the class interests of consumers and suppliers are best served when goods and services are bought and sold under conditions of a perfectly competitive market: there are many buyers and sellers, none dominant, each of whom may easily enter or exit the marketplace and each of whom may easily alter his/her business associations; and, each party has complete information about a product or service through its price, since all costs are internalized.[26] According to the theory, the long-term interests of all parties are best served in perfectly competitive markets; the largest number of goods will be produced at the lowest overall price. Both neo-populist and private enterprise values would be jointly served by these arrangements.

As conditions in a particular market depart from this theoretical ideal, private enterprise and neo-populist values may increasingly conflict. If a market is dominated by few suppliers, prices may be too high and the market will 'inefficiently' produce too little. If all costs are not internalized in the price of a good, the market will price it too low, too much will be produced, and the real costs to consumers will be excessive. In that event, private enterprise criteria will dominate neo-populist values. (For example, the price of gasoline does not include the cost of cleaning up smog.)

Neo-populist critics of North American enterprise often equate size with market power. In their eyes, large organizations should not be trusted to act in the public interest: the major car manufacturers, 'big oil', and 'big government' all merit distrust. The US banking industry, with 19000 banks of different kinds and sizes, might appear highly competitive. However, banking is highly concentrated in local markets and nationally in the USA. In many cities, a handful of banks have the majority of accounts. In 1973, the 100 largest banks, 0.5% of the banks, held 70% of the funds on deposit. Through bank mergers and acquisitions of bank holding companies, this industry has become more concentrated during the last decade. Since banks are authorized to operate in a given city or state, competition is currently focused on local rather than on national markets, which are also highly concentrated.

Some advocates of EFT services argue that banks should be allowed to extend their services via terminal networks into new markets. Banks are forbidden by federal law to operate in more than one state, and some states prohibit branch banking, although these limitations are being fought and removed. According to advocates of extended banking services, these laws are simply archaic. It should be possible, in this view, for the residents of Eugene, OR, to have easy access to the services of the

[26] Edwin Mansfield, *Microeconomics*, W.W. Norton, New York, 1981.

Chase Manhatten Bank, Citibank, Bank of America, Security Pacific, and the Chemical Bank of New York by allowing them to place teller machines in convenient locations nationwide. After all, no one objects to rows of candy machines or clusters of gas stations on the corners of intersections.

Representatives of smaller banks and of consumer groups believe that the expensive EFT costs can be more easily afforded by the larger banks. They fear that EFT developments will further accelerate the concentration of the banking industry. After all, it is more likely that large banks such as Citibank or Bank of America will extend teller machines to Eugene, OR, than that a small institution such as Laguna Federal Savings and Loan will. Those who fear a further increase in the concentration of the banking industry exacerbated by extended bank terminal systems argue that bank terinals should be mandatorily shared. In that way, if Citibank were to place a teller machine in Eugene, Laguna Federal Savings and Loan could also offer services to Eugene residents over the same terminal at a fair fee.[27]

In these debates, consumer groups utilize neo-populist criteria. Bankers utilize both neo-populist and private enterprise criteria in justifying their preferences.

Consumer convenience and protection

If a person uses an EFT system, what protections does he have if transfers are made without his authorization, if he wishes to stop payment, or simply if there is an error? What kind of control does the individual have over his transactions? To what extent is the EFT provider liable? To what extent is the customer liable? In consumer protection, as in other market issues, the positions taken by various parties seem to hinge in large part on a priori value commitments. People who trust current market structures or who view the recent pro-consumer regulations as inimical to their own interest or to the broader public interest advocate reliance upon current market forces to select the best services. In their view, neo-populist and private enterprise values can be jointly served. Other analysts view the US economy as increasingly controlled by several hundred large corporations which are usually protected by the regulatory agencies that were originally supposed to oversee them. According to these analysts, reliance upon current market and regulatory arrangements would not serve the broad public interest. They point to the vigour with which specific industries have fought consumer reforms, such reforms as truth-in-advertising and fair credit reporting. Neo-populist advocates have been active, pressing for laws which limit the financial liability of consumers in case of errors in EFT systems, limit liability for unauthorized transfer, and increase consumer control by mandating stop-payment or reversible payment mechanisms.

In 1978, the US Congress enacted a special law, informally called the EFT Act (EFTA) which improved the kinds of protections for consumers using many kinds of EFT services.[28] It covers all transactions initiated through electronic terminals (eg telephone bill payment,[29] automated teller machines, and preauthorized debits and deposits), but not those initiated with paper instruments (eg truncated checking). EFTA mandates that financial institutions make disclosures in 'readily understandable language' about the timing of transfers, charges, whom to notify in the event of unauthorized transfers, etc. The Act provides for consumer liability for unauthorized transfers on a sliding scale. While the law is

[27]Some states in the USA, such as Iowa, have mandated sharing, while other states, such as California and Massachusetts, have not.

[28]Title XX of the Financial Institutions Regulatory Interest Rate and Control Act of 1978, Pub. L. No. 95–630 and 2001, 92 Stat. 3641 (1978) codified in 15 USC & 1692.

[29]'Telephone bill payment' is a kind of service for paying bills such as rent or utilities via touchtone phone.

ambiguous, a common reading suggests that consumers are absolved of financial responsibility if they report the loss or theft of an EFT card within two days, while they are strictly liable for unauthorized transfers if they wait over 60 days. Between these periods, they can be liable for up to $500.[30] The EFTA also specifies some procedures for resolving errors.

But the EFTA does not enable consumers to reverse or stop payments, nor does it prevent employers, creditors, or public agencies from requiring that a person use an EFT-based service to transact business. Also, many of the record-keeping, liability, and error-resolution procedures will work best for people who are sophisticated in their financial dealings, who keep good paper records, who are especially alert, and who are adept at resolving conflicts with bureaucratic organizations. Those people who are less 'bureaucratically competent' will probably have some troubles.[31]

The EFTA is a compromise. It provides more protection to consumers than private enterprise advocates desired, but far less protection than neo-populists advocated that Congress provide. As long as EFT systems are discretionary, they will most likely be used by those who can best cope with them. They do promise greater convenience for many routine transactions when they work well, yet they require substantial symbolic and organizational skills in order to detect and resolve problems when difficulties arise.

Privacy of personal transactions

In the popular conception, computers and concerns about privacy go hand-in-hand. Privacy connotes a complex array of issues: what information shall be collected about a person?; how shall a person know about, complete, or correct a record (due process)?; to whom and under what conditions shall personal records be made available (confidentiality)? A common view treats privacy as an elementary social exchange: people who desire a service relinquish certain information so that the provider may make a sound decision.

While this view locates privacy of personal data in the relationship of exchange between providers and clients of a service, it misses the ways in which much financial data collected by organizations in the late twentieth century is passed around to a wide array of third parties who in turn use it for a host of purposes which are well outside the control of the client.

Privacy issues in EFT can be illustrated with the example of automated cheque processing (ACP)[32] systems and bank records. ACP systems record to whom each person writes each cheque. This information, along with the date of the transaction, a cheque identifier, and the amount of transaction appears in the person's local bank record. A record of each payee is necessary in the event that a receipt is required and in order that the customer may audit his account. All this information is available now, since each bank microfilms every cheque cashed against one of its account holders and keeps it on file for six years, in accord with the Bank Secrecy Act of 1970.

Such records are a rich source of social data. US Supreme Court Justice Douglas once noted that:

> In a sense, a person is defined by the checks he writes. By examining them, the agents get to know his doctors, lawyers, creditors, political allies, social connections, religious affiliation, educational interests, the papers and magazines he reads, and so on, ad infinitum.

[30]Ellen Broadman, 'Electronic Fund Transfer Act: is the consumer protected?', *University of San Francisco Law Review*, Vol 13, No 2, Winter 1979, p 245–272.

[31]Budnitz, *op cit*, Ref 24; Kling *et al*, *op cit*, Ref 5; and Bob Sipchen, 'The creature that came out of the vaults', *Los Angeles*, Vol 27, No 12, December 1982, pp 261–265, 430–435.

[32]Cheque truncation, a procedure in which a paper cheque is kept by the depository institution or the first bank to receive the cheque, is an example of an ACP system. An ACP system is operated by Bank One of Columbus, Ohio for clients of Merrill, Lynch, Pierce, Fenner and Smith's huge 'CMA' money market fund.

In EFT systems, disclosure of information to third parties is the primary privacy issue. Typically, such data are sought by police and grand juries conducting legitimate investigations. But the data is sometimes sought by these same agencies acting against their political enemies. With manual records, the cost of finding out whether a particular individual wrote a cheque to a particular party or group is prohibitively expensive. With ACP systems, they would be neatly filed in machine-readable form for six years, under the supervision of the Bank Secrecy Act of 1970.

The array of personally sensitive data made accessible is compounded in other EFT-related systems. Point-of-sale networks can be used to track the movements of particular individuals. Credit card or debit card files will also contain records of hotels stayed in, restaurants frequented, and other personal activities.

Libertarian criteria emphasize system designs, organization practices, and laws which minimize intrusiveness, maximize fairness, and maximize the control individuals have over the content and confidentiality of their records in the absence of competing concerns which outweigh the need for individual control. Advocates of statist and private enterprise positions emphasize the needs large organizations have for information, the costs of implementing due process procedures, and the infrequency of abuse.

In 1978, the US Congress passed the Financial Privacy Act, which extended an individual's rights regarding financial data kept about him by his bank, credit union, or similar organization. During the 1970s, several important court cases reduced the extent to which a person could have property rights over records about him (eg control their release to third parties). The 1978 Financial Privacy Act dictated that individuals' financial records were subject to property rights. These rights were declared to be partial, rather than complete. For example, the Act requires both that a bank inform its customers of the general conditions under which it discloses information to third parties (eg employers, public agencies, market research firms), and that it inform a customer if data about him has been subpoenaed by a court, but it does not require that the customer be informed whenever data about him has been released to a third party.[33] Nor does it require public agencies to obtain a court order before obtaining data about a customer. Nor does it limit the period of time that a depository institution should keep data about a customer.

This law, like the EFTA, is a compromise between parties with different values. In addition to advocates of libertarian and private enterprise values, advocates of statist values were major actors in the debate, arguing that public agencies should have unlimited access to financial data to pursue investigations and other mandated activities. In the net, libertarian values have suffered somewhat more than statist or private enterprise values by these legal developments related to EFT-based services.

Differing incentives for EFT developments

Making value stances explicit helps us interpret the meanings various interest groups have assigned to particular issues related to EFT systems. Focusing on value orientations also sharply illustrates an important aspect of computing's social impact. To the extent that value orientations conflict, it is impossible to develop policies that will optimize all parties' goals and interests simultaneously.

To understand how conflicts are resolved in the marketplace, it is

[33]Office of Technology Assessment, Congress of the United States, *Selected Electronic Funds Transfer Issues: Privacy, Security and Equity*. US Government Printing Office, Washington, DC, 1982.

important to recognize that even though EFT systems can foster some form of social progress, they are costly and will be developed by organizations with particular interests. While many EFT systems are to be used by the larger public, they are selected, financed and developed by financial institutions, retail firms and public agencies which embed them in their own operations. EFT systems have been most forcefully advocated and developed by groups which employ predominantly private enterprise or statist criteria for social choice. The following four examples of the interests which dictate use of EFT services include two that illustrate predominantly private enterprise interests and two that illustrate statist interests:

- Supermarkets and small businesses in the USA often suffer large losses from bad cheques. Computer-based credit authorization services enable a merchant to reduce his losses.
- North American firms that advertise by mail often identify potential customers in terms of their demographic characteristics. Yet the knowledge that a person recently purchased a similar service is a better predictor of the likelihood that he will purchase a given service than is his membership in some demographically defined group. As financial transactions become automated, the pool of potential market data either for internal use by large retail firms or for sale by credit card firms could increase substantially and provide merchants with more effective mailing lists.
- The US Government's Federal Reserve Board (Fed) processes about 10 billion cheques annually for member banks, but is prohibited from passing its costs back to the banks. Banks have been steadily leaving the Federal Reserve System since the second world war. The Fed provides special loans and market information in exchange for member banks' maintaining relatively high reserve funds on account without interest in the reserve system. If the Fed administered a national EFT infrastructure, it could increase the accuracy and timeliness of its data about transactions in the economy. If automated cheque processing systems could lower the cost of cheque handling, the Fed could lower its overheads. Improved information and reduced reserve requirements might entice banks to re-enter the Federal Reserve System and thereby help increase the Fed's effective control over monetary policy.
- By the end of 1981, more than 36 million people were receiving social security benefits. Automating the transfer of credit to social security recipients could save a large part of the costs of preparing and mailing monthly cheques. In addition, theft of cheques from post boxes would be eliminated.

To understand computing developments like these, it helps to distinguish benefits from incentives. An incentive is an expected good that induces a party to take action, while a benefit is any good derived from the action taken. Incentives precede benefits. It may benefit individuals to receive fewer unwanted advertisements, but the incentives for developing special-interest mailing lists would be the decreased costs of advertising borne by retailers and hence, by their customers. Some incentives, particularly those that emphasize competition for new customers, also promise benefits to consumers through convenient new services and faster credit through preauthorized payments. However, cost-savings to EFT-using institutions is more problematic. The little publicly available

data with which we can assess the claims for cost savings indicates that most EFT systems become cost effective only with very high transaction volumes. The high capital costs of EFT systems and the high volumes of business which they require makes consumer acceptance vital.

Some incentives are more important than others to EFT-using organizations. It is unlikely that individual banks would save a substantial portion of the cost of paper handling with EFT systems. Rather, fear and hope drive many private organizations into developing EFT systems. A firm that develops EFT-related services may gain new customers; one that delays much longer than its competitors may lose out.

While private enterprise and statist interests encourage many organizations to develop specific EFT arrangements, some consumer convenience (a neo-populist goal) may result from them. However, no one argues that enhancing libertarian values are either a major incentive or a likely consequence of large-scale EFT developments. Last, systems advocates and those favouring consumer convenience may favour more integrated services (eg fewer cards and terminals).

The relatively few auspicious developments in the emergence of EFT for advocates of libertarian or neo-populist viewpoints may be underscored by reversing our analysis. EFT technologies may help solve some of the problems faced by profit-making firms or public agencies in carrying out their activities. But advocates of neo-populist criteria, who stress institutional and legislative reforms to render large organizations more accountable to the public, are unlikely to view EFT systems as important strategic instruments. Similarly, libertarian analysts, who are concerned about minimizing the intrusiveness of organizations into people's private lives, do not consider EFT technologies to be important means for protecting individual liberties.[34]

Computers and schooling in the USA[34]

EFT systems are now beginning to appear in many different North American cities, but they account for only a tiny fraction of all financial transfers; computers for instructional purposes are also just beginning to become commonplace in North American schools, but only a tiny fraction of students have any extended contact with them. We are also witnessing the infancy of computers in both instances.

There is little consensus about how computers should be integrated into school curricula in the USA. Some argue that they should be used to teach computer literacy,[36] and often tacitly identify computer literacy with programming skills and knowledge about the workings of computers. Others emphasize the special role that computer based systems can play as instructional aids, but people vary considerably in their views, some valuing drill and practice in existing curricula, and some finding drill and practice thoroughly pedestrian, and arguing for more progressive, discovery-oriented learning in richer, student driven computerized environments.[37] In addition, several companies have begun to market courseware for computer systems. The larger companies, such as the SRA Division of IBM, emphasize materials like drill and practice which are easily integrated into standard curricula, and can be easily purchased by many school boards without requiring that the organization of schooling in the USA be fundamentally altered. Other, smaller companies, such as Terrapin, Inc, are emphasizing more intellectually innovative materials, such as Turtle Geometry,[38] which appear to be

[34]Rule, *et al*, *op cit*, Ref 3.

[35]In this article I emphasize schooling, rather than education. By schooling, I mean the rather narrow range of activities that take place in schools. The term 'schools' is used to refer to elementary, middle, and high schools, as we know them in the USA. They may be public or private, more or less structured, and they are characterized by sets of social arrangements to require attendance of specific age groups in teacher-supervised classes for the study of graded curricula (Ramon Sanchez, *Schooling American Society: A Democratic Ideology*, Syracuse University Press, Syracuse, NY, 1976, p 147). If a parent teaches his/her children at home according to a curriculum approved by a legal authority (eg local or state board of education), that should fall well within this conception of schooling. 'Schooling' is not the same as 'education' or 'learning'. In the USA, school age children spend about 13% of their time in required schools (Angela E. Fraley, *Schooling and Innovations: The Rhetoric and the Reality*, Tyler Gibson Publishers, New York, 1981, p 6), and perhaps 33% of their time sleeping. About 54% of their time is not accounted for by required schooling or sleep, and doubtless they learn a good deal during these other hours.

[36]Linda Wyrick Winkle and Walter M. Mathews, 'Computer equity comes of age', *Phi Delta Kappan*, Vol 63, No 5, January 1982, pp 314–315.

[37]Alfred Bork, 'Interactive learning', in Robert P. Taylor, ed, *The Computer in the School: Tutor, Tool, Tutee*, The Teacher's College Press, New York, 1980; and Pappert, *op cit*, Ref 20.

most easily integrated into the organizational style of open classrooms.

Many of these efforts are marked by strong advocacy and salesmanship.[39] Despite the small and vigorous industry of many teachers, courseware developers and marketing specialists, it is difficult to find coherent and extended accounts which suggest how different forms of learning with, through and about computers fit into the larger picture of schooling in the USA. Most accounts which discuss computer literacy simply indicate that computer use is becoming widespread in the USA, and assert that 'well educated' people need to be able to understand or 'cope with' computerized technologies in the larger social order. Most discussions of computer assisted instruction emphasize microsocial learning and the kind of intellectual richness or cognitive skills which can be enhanced through the author's favourite style of computer-assisted instruction (CAI).[40] While many of these accounts are interesting and suggestive, they do not go very far toward examining how instruction-oriented computers in schools will alter schooling, if at all.[41]

Value positions relevant to schooling

What does the increasing spread of computers in school curricula mean for students, teachers, parents and others in the communities which adopt instructional computing? Will the kinds of things that children learn in school and the ways in which they learn them be altered in some fundamental way? Children, after all, learn more than 'the three Rs' in school. They learn social skills, as well as a broader array of beliefs about how society is organized and their place within it. In addition, will schooling in the USA be more equitable or inequitable for children of different social classes?

These questions do not have specific answers. However, we can gain important insights into their answers by developing an analysis which parallels that of EFT arrangements. First, we should identify the major value criteria which educators and others use to identify what good schooling should emphasize. Then we can examine how different arrangements for organizing school education with and around computers influences what will be learned and who will have access to different kinds of education in our schools.

The literature and debates about what schools are and can be in the USA is extremely diverse. The following three value positions capture some of the main concerns of those who have studied the relationships between schooling and how people live and work in the larger society:

Vocational match model: Good schooling arrangements are those which enable students to develop the cognitive and social skills necessary for working in the society they will find when they leave school. The character of the social order is largely independent of schools.[42] Changing job requirements should be anticipated by schools.

Progressive schooling model: Good schooling arrangements are those which encourage students to develop their intellectual curiosity and to develop social skills which support relatively democratic group life.

Egalitarian schooling model: Good schooling arrangements are those which enable students of all social backgrounds to have equal opportunities in employment by virtue of the cognitive and social skills they develop. Moreover, good schooling arrangements teach children values and social skills which support more egalitarian and less hierarchical

[38]Pappert, *op cit*, Ref 20.
[39]Bork, *op cit*, Ref 37; and Pappert, *op cit*, Ref 20.
[40]See, for example, Taylor, *op cit*, Ref 37.
[41]For an interesting exception, see Mowshowitz's account which discusses some of the early CAI experiments in the context of school reforms in the USA (Abbe Mowshowitz, *The Conquest of Will: Information Processing in Human Affairs*, Addison-Wesley, Reading, MA, 1976). Also, see Anthony Oettinger and Lema Marks, *Run Computer, Run: The Mythology of Educational Innovation*, Harvard University Press, Cambridge, MA, 1969.
[42]Harold G. Shane, 'The silicon age and education', *Phi Delta Kappan*, Vol 63, No 5, January 1982, pp 303–308; Roy H. Forbes, and Lyn Groves Gisi, 'The information society: will high school graduates be ready?', *The School Administrator*, Vol 39, No 4, April 1982, pp 16–17.

social orders (eg cooperation and appreciation of diversity rather than sharp competition).

These three value positions help identify the key elements of rather complex arguments about the appropriateness of basic skills, computer-assisted instruction, open classrooms and other curricular reforms in the USA. They also help identify the connections between a population of 'schooled children' and the larger society in which they live and will work.[43] Proponents and critics of specific school reforms often anchor their main arguments in one of these three positions, although few people maintain a rigid fidelity to one value model exclusively. For example, John Dewey is usually identified with the progressive orientations, but some of his writings emphasize vocational matching.[44] Identifying these themes in the writings of school reformers is also difficult because of the differences between what people believe about the way that a certain kind of schooling operates in the USA in contrast with their preferences about how it should operate. Thus, some egalitarian reformers criticize North American public schools for acting in ways which those who value vocational matching would applaud.[45]

Two other value positions are also sometimes argued, but rarely in print. These are variations of the private enterprise and statist value orientations which were discussed as pertinent to EFT developments. In discussions about schooling, the major actors to anchor their arguments in private enterprise criteria are the publishers and manufacturers of curricular materials and school products. To them, schools are markets. They are concerned that schools be sufficiently uniform and stable in terms of preferences for materials so that the producers can depend on large markets and keep their development costs to a minimum by spreading them over many buyers and several years.

A statist position is expressed by those school administrators, teachers and parents who are concerned that schools be organized so that they can be managed at many levels of social aggregation (eg mandating order in all classrooms and maintaining curricula that are sufficiently standardized so that students can easily transfer from one school to another). Identifying value orientations provides us with a special vantage point from which to examine computing developments in US schools, much in the way that it helps us understand the social choices in the deployment of EFT technologies.

Computer literacy

'Computer literary' is an attractive metaphor for indicating some skill in dealing with computerized systems. Most of the discussion of this topic hinges on differences in belief about what kinds of skills are relevant, and differences in conceptions of 'computerized systems'. The narrow conceptions of literacy emphasize skills in manipulating computerized devices such as microcomputers or word-processing machines. A broader, more socially rich view holds that these skills, while useful, are far from sufficient to acquaint people with such practical matters as the opportunities and problems of large-scale EFT developments or supermarket scanners.[46]

An analogy between computers and automobiles might prove instructive. Advocates of literacy-as-computer-manipulation are proposing a kind of learning similar to driver education or automotive mechanics. If cars (or computers) are widespread, it is doubtless useful to teach people

[43] These three value positions are tentative constructions and their utility should be carefully explored before 'freezing' them. Not all value positions will provide equal insight. For example, Chesler and Cave identify three value orientations which they believe highlight important differences in the intent and outcome of schooling strategies: reactionary, conservative, and revolutionary. These labels are defined relative to a whole society, rather than as a strategy for organizing schooling within a single society. Hence, they don't provide us any analytical leverage here (Mark Chesler and William M. Cave, *Sociology of Education*, MacMillan, New York, 1981).

[44] See, for example, Walter Feinberg and Henry Rosemont Jr, 'Training for the welfare state: the progressive education movement', in Walter Feinberg and Henry Rosemont, Jr, eds, *Work, Technology, and Education: Dissenting Essays in the Intellectual Foundations of American Education*, University of Illinois Press, Chicago, 1975; see also Sanchez, *op cit*, Ref 35, pp 80–85.

[45] Sanchez, *op cit*, Ref 35.

[46] An intermediate view assimilates 'computer literacy' more to cultural sophistication than to linguistic fluency and technical mastery (Carolyn Marvin and Mark Winther, *Computer-Ease: A Twentieth-Century Literature Emergent*, Annenberg School of Communications, University of Pennsylvania, January 1982. In this conception, dealing with computers hinges on learning how to negotiate with the computing cultures within which computers are embedded (see also Rob Kling and Walt Scacchi, 'The web of computing: computer technology as social organization', *Advances in Computers*, Vol 21, Academic Press, New York, 1982.

how to deal with them in rather concrete and practical ways. Moreover, such people will have more appropriate skills when they enter the full-time labour market (thus the narrow literacy position is congruent with vocational-matching educational values.)

The broader (institutional) approach to computer literacy emphasizes the ways in which computerized systems are integrated into the social order, much as we have seen with the EFT examples discussed earlier. In this conception, a person's understanding about how computers work and what they are good for depends on both understanding the machinery and the social order within which it is used. Providing a child with a microcomputer may help him/her understand what software is and how it works far better than a textbook description could do.[47] But access to a microcomputer would do little to help that child (or an adult) understand why banks have three tier liability systems for the unauthorized use of debit cards, or why the US armed forces have trouble developing a workable multiservice command and control system for unified military commands, after 15 years of development and $1 billion expenditure.[48] Understanding these matters requires an appreciation of how computer-based technologies are integrated into organizational and social worlds.[49]

Using computers to develop new skills and a sense of competence, teaching children to program relatively flexible and accessible machines, can be rewarding and helpful for many children. But each point of view cashes out this development differently. To refer back to our analogy with automobiles, the institutional approach to computer literacy would hold the analogous position that understanding the role of cars in US society is not equivalent to having acquired skills as a driver or mechanic, however fun or useful these may be. Rather, an adequate grasp of the role of cars requires understanding the development and deployment of automobiles in US cities and in the economy at large, so that one can appreciate the importance of oil in US life, why the demise of Chrysler in the automobile industry cannot be taken lightly, and so on. Those who advocate an institutional approach to computer literacy typically hold to more egalitarian values of schooling also. They believe that it is not sufficient for schools to simply educate children to 'fit' into society, but that schools should, in part, educate children to understand the workings and myths of the society they live in.[50] Those who hold egalitarian values toward schooling seek ways to prevent students' schooling in computer literacy (as well as other fields) from simply reflecting a hierarchical job market with many jobs which allow little initiative and a small fraction of jobs which offer considerable discretion, intellectual challenge, and deep personal rewards.

Computer assisted instruction (CAI)

Computer applications and environments can be designed in many ways to assist students in learning and improving (usually) cognitive skills. The most structured and least intellectually exciting are drill and practice programs which are written to support basic skills such as reading, elementary mathematics, and other highly structured intellectual domains.[51] (These programs can also spin off progress reports about the tempo and development of each student in a class). The middle range of CAI technologies are simulations which allow the student to explore the dynamics of a physical system or a simple economy by asking his or her own questions.[52] The high end of CAI technologies are rich environments such as Turtle Geometry, environments which enable students to

[47]Arthur Luehrmann, 'Technology in science education', in Taylor, *op cit*, Ref 37. It is instructive to read the argument for computer literacy as vocational matching in light of Tyack and Hanson's observations about the advocates of vocational education in the USA around the turn of the century:

'The literature on vocational education is a fascinating index of the way in which the new educational managers could perceptively diagnose the severe problems created by the new forms of corporate capitalism and then provide paltry remedies. It also exemplifies their faith in the power of public schooling to correct structural inequities by improving individuals, to reform the society not by direct means but by teaching youth. Advocates of vocational schooling wrote study after study documenting the ill-paid and deadening character of the subdivided and routinized work available to those on the bottom of the system. They argued that it was so exploitative that child labor should be forbidden by law. But at the same time few suggested any fundamental changes in the character of work for adults or thought of altering the balance of power between workers and employers in industries. They placed their hopes on a better system of vocational training that would help workers to be more productive and to understand the larger significance of the work they performed (David Tyack and Elisabeth Hanson, *Managers of Virtue: Public School Leadership in America, 1820–1980*, Basic Books, New York, 1982, p 111).

[48]Kling, *op cit*, Ref 8.

[49]Kling, *op cit*, Ref 21.

[50]Moshowitz, *op cit*, Ref 41; Paulo Freire, 'Extension or communication', in Paulo Freire, *Education for Critical Consciousness*, Continuum Publishing, New York, 1981. Since this (socially rich) conception of computer literacy depends upon students developing accurate portraits of social life in America, it is unlikely to be taught in most public and private schools. For an illustration of this point, see Fitzgerald's examination of the changing portraits of American society which have been emphasized in high school history books. Historical fidelity, Fitzgerald observes, is not their strength (Frances Fitzgerald, *America Revised: History Schoolbooks in the Twentieth Century*, Random House, New York, 1979).

[51]Patrick Suppes, 'Computer-based mathematics instruction', in Taylor, *op cit*, Ref 37.

[52]Bork, *op cit*, Ref 37.

explore mathematical ideas by providing computational tools which are suitable for many 'experiments' and an environment which is driven by the student much more than by the courseware.[53]

Only a tiny fraction of school-aged students in the USA are now exposed to CAI in any form. Clear trends are difficult to identify, and the shape of things to come may diverge radically from the current pattern of developments and adoptions. Nevertheless, the present does provide some insight into the larger social forces which are building the future, visions of which have so inspired CAI pioneers.[54] In 1982, about two dozen firms sold educational courseware. Most of the materials (judging by their titles), and the largest firms concentrate on drill and practice and similarly structured packages. While the pedagogy of rote learning and the structuring of these media often incite contempt from developers of intellectually richer materials and media,[55] highly structured materials are the most easily integrated into the standard school curricula. The use of less directive media, such as Turtle Geometry, probably hinges on an open classroom organization. The major experiments with Turtle Geometry are taking place in an open and relatively experimental school in the Dallas system[56] with the support of Texas Instruments, and in a progressive suburban school district (Newton, MA), this one without explicit industrial support.[57]

There is much to be optimistic about during the next decade. First, the cost of the cheapest computers may still decline, while their computational power, graphic capabilities, and associated input/output (eg auditory drivers) will be substantially magnified. Second, the richness of the software available for the popular machines and also the quality of the more popular kinds of courseware will improve. Also, more schools will doubtless purchase computers and courseware for instructional use. But these are all endogenous elements; that is to say, they do not directly translate into an altered form of schooling in the USA. Little else needs to change except the sheer presence of computers and the shift of some coursework from paper and pencil to terminal and display. Computerized technologies seem to be going the way of multicoloured textbooks and felt-tipped pens – widely used, adding some interest, but having little fundamental impact on schooling nationwide.

Before deciding that the future is to be unexciting, however, we should turn again to our value models to appreciate the alternative kinds of schooling which these instructional technologies are most likely to support. Advocates of progressive education and student-centred learning will favour the richer, more student-directed technologies. (They may also favour those drill and practice systems which allow self-pacing for students who require remedial training.) While the 'content' of drill and practice systems can be drawn from any discipline and skill instruction and testing can be framed around right and wrong answers, simulations and computational environments are constrained to those symbolic worlds for which someone can build an explicit symbolic representation. It is easiest to do this for knowledge domains in which the underlying relationships can be mathematically modelled (eg physics force laws, simple economies, Turtle Geometry). However, the kinds of symbolic worlds which appear in games like 'Adventure' suggest that a larger class of symbolic universes can be transformed into a computationally accessible representation. These are not unlimited, although it is easiest to say that at any given time, they are bounded by the scope of the artificial intelligence technologies of that period.[58]

[53]Papert, *op cit*, Ref 20.
[54]Taylor, *op cit*, Ref 37.
[55]Bork, *op cit*, Ref 37; Papert, *op cit*, Ref 20, pp 21–35.
[56]Edward B. Fiske, 'Computers alter life of pupils and teachers', *The New York Times*, Section 1, pp 1, 42, April 4 1982.
[57]Jon Zonderman, 'Starting them young: computers in the public schools', *The Boston Phoenix*, Section 4, pp 22–25, 11 May 1982.

For a host of reasons too complex to discuss here, it is doubtful that CAI of any sort will substantially replace printed books in social studies or literature. Thus, educators, school boards and parents who value progressive educational approaches and who are drawn to CAI may employ drill and practice systems and some of the richer computerized environments as part of a larger curriculum.

Those who believe that schools should emphasize vocational matching will see the adoption of CAI technologies somewhat differently. There is little opportunity for most school graduates who have a deep appreciation of physics or a love of mathematics to find suitable employment in our current economy, and in the economy of the next few decades. Even if there is a continuing shift of employment from agriculture and manufacturing to services and information handling, many of the available jobs will require relatively limited skills and a temperament adapted to routine work in complex, rule-laden organizations. It is most likely that those who are educating students for these labour markets will prefer CAI systems which are most consistent with structured classrooms and basic skills (even if they enlarge these skills to include elementary computer programming or word processing or machine operation). Simultaneously, students who aim at jobs which hinge on a college education and more sophisticated scientific and formal language skills and which require more independence are more likely to be taught in schools which have more student-centred teaching. The richer modes of CAI might appeal to vocational matchers who are selecting instructional materials for this more elite segment of the school age population.

Those who prefer egalitarian values would probably not have a priori preferences for any special mode of CAI. They would, however, be concerned that classrooms, with or without CAI, foster cooperation between students rather than sharp competition; that students are not sharply 'tracked'; and that there are no vast gaps in the kinds of educational resources which are available to schools across the USA. Today, CAI systems are relatively expensive, and thus they are most easily affordable by the wealthier (or subsidized) school districts. Many people expect the costs of CAI to be substantially reduced in the next decade. If the costs of CAI systems can be reduced so that their costs are comparable to textbooks or typewriters, the best served students will be those who have teachers who are most skilful in teaching with computer-related materials.

These teachers, like skilful teachers today, are not uniformly distributed throughout the public and private schools. To the extent that wealthier districts attract a disproportionately larger number of them, it is likely that CAI systems, in themselves, can do little to redress existing inequities in US schooling. To the extent that artful teaching with CAI demands even greater skill from teachers, CAI systems may exacerbate inequities. Unfortunately, educational outcomes may hinge more critically on the intervention of skilful teachers in the use of intellectually richer environments rather than the more routine drill and practice applications.

Open issues in computers and schooling

The most common point of departure for discussing instruction about and through computers in the schools is to take advances in computer hardware for granted, and to ask how rapidly new technologies can be taught with and through them.[59] In light of this approach, the most problematic

[58] In practical terms, one will not find programs in the next decades which will answer important questions about US history, for example, in intellectually satisfying ways. A drill and practice program might store many facts about the outbreak of World War II, and a simulation might model the relative strength of world armies of the period. But the programs we know and understand would be hard put to answer inquiries about why US forces were surprised at Pearl Harbor on 7 December 1942, how the British staved off severe V2 attacks, why Hitler broke his non-aggression treaty with Stalin, or the rationale for and effects of the Allied saturation bombing of major German cities. If pedagogy is to be more than simply propaganda, then a key point in discussing questions like these in a classroom is not simply to get a correct answer, but to examine how people and nations act. The underlying pedagogy is unlikely to be completely replaced by some specially good World War II or foreign policy simulation.

While simulations in principle help one examine the dynamics of a given situation, one needs models of individual and collective behaviour which link expectations, cultural preferences, and the 'drift' of collective situations in shaping policy action and large scale social responses. It would be an understatement to say that decent models of such explanatory scope are well outside the bounds of contemporary theory.

elements are the difficulties in finding high quality courseware, of convincing school boards and teachers to adopt innovative teaching technologies, for training teachers to work in computer centred environments, and of finding ample funds for these ventures in a time when school expenditures are scarce. In this technology-centred approach, better cognitive skills and greater computer appreciation are the most important outcomes of instructional computing.

I have sketched an alternative way of asking what computerized technologies mean for schooling in the USA based on competing value positions. From these vantage points, different forms of computer literacy and CAI appear differentially attractive and workable. In short, those who value schooling as an institution for chanelling students into different slots in the labour markets will find narrow conceptions of computer literacy and many kinds of CAI attractive. This does not mean that vocational matchers will always value computer literacy as a basic skill to be taught in conjunction with 'the three Rs'. Nor does it mean that they will eagerly seek CAI at every juncture, or be forgiving about costs, teacher training, etc. It simply means that they will select those portfolios of instructional computing which are consistent with their vision of schooling, and reject the residue. Since there is a rich variety of jobs and competencies required in the US economy, vocational matchers can argue for a diverse portfolio of instructional computing even if it is not equitably distributed among schools.

The current arrangements for schooling in the USA tend to favour vocational matching,[60] although there are some compensatory funding programmes to reduce the more extreme inequities in some states in the USA (eg California). Vocational matching arrangements are also consistent with having a fraction of schools administering progressively oriented programmes, such as open classrooms.[61] However, those who value egalitarian schooling should also value an institutional approach to computer literacy and an equitable distribution of talented teachers. Overall, current schooling arrangements are so organized that the largest markets for curricular materials will be those which support relatively narrow forms of computer literacy and relatively well-structured forms of CAI. These are the markets which I would expect the firms which value profitability to emphasize, although there are always niches for small, specialized suppliers.

This analysis has emphasized the pedagogical side of schooling. However, pedagogy is not the only issue in organizing school work in a classroom. Many teachers value orderliness, particularly in traditional teacher-centred classes. There is a good chance that those kinds of instruction about and through computers which will be adopted on a large scale are those which enhance, or at least do not erode, the extent to which teachers can maintain control over the attention of the children they supervise. (Thus, computer-based programs which can be used by individual children would be preferred to those that hinge on small groups cooperating. This is an hypothesis; not a firm prejudgment).[62]

There are many questions still to be addressed – the role of computer-managed instruction, the relations between students and teachers, the likelihood that many parents will prefer to teach their students at home rather than in teacher-staffed schools, etc. The value-model approach developed here should help to illuminate some of the key social forces and dilemmas that underlie these issues.

[59] Taylor, *op cit*, Ref 37, for many examples

[60] Herbert Gintis and Samuel Bowles, 'The contradictions of liberal educational reform', in Feinberg and Rosemont, *op cit*, Ref 44.

[61] Sanchez, *op cit*, Ref 35.

[62] Much of the literature on the more student-centred forms of CAI emphasizes the technology to the neglect of the real children who will use these devices and the real classrooms in which they will be taught. See Taylor, *op cit*, Ref 37, and Peppert, *op cit*, Ref 20, for examples where the technology is foregrounded: there are no explicit and careful descriptions of the students and classes. See Oettinger and Marks, *op cit*, Ref 41, for an alternative approach which is sensitive to the social contexts of real schools. CAI technologies are now cheaper and more sophisticated than in 1969, but many issues they raised remain unresolved.

Value conflicts in different computing arenas in the USA

It is common to view technologies as potent forces which foster rapid social change,[63] but the most significant technologies are diffused through modern societies over several decades. Automobiles, telephones, electricity, central heating, television and birth control did not act as independent, powerful forces in the USA. They were shaped and fitted so that the larger social order was not radically uprooted. There is evidence that computerization develops similarly within public agencies.[64] It is also likely that EFT technologies and instructional computing will be similarly absorbed over several decades. We still have much to learn about the social dimensions of other computer technologies from these two cases.

In the short run, when these technologies substitute for less technically sophisticated alternatives, the values of key actors – developers, resource controllers, and users – play a critical role in setting the stage for later developments. Later on, new styles develop; eg automobiles do not function like horseless carriages and photocopiers do not function like automated carbon copiers.

In the short run, institutional styles dominate the use of new technologies. Hospitals which use computers heavily are much more like hospitals which are hardly automated than they are like some other kind of institution – a bank, a grade school or an architectural firm. Thus, one who asks how a technology shall be best used is also asking questions about the larger social context in which it is embedded. Identifying key values at issue in a given institutional area – here banking and schooling – may help to identify the kinds of interests that easily align with different modes of computerization.

It is not a bona fide issue whether or not computers are used in banks or schools or libraries or manufacturing firms. How they are used, what infrastructure of resources and legal arrangements accompany their use, and what interests the arrangements serve are the questions we need answers to. Much is written about the promise of computers in many spheres of US life. Despite the billions of dollars spent each year on different forms of computerization, we have little systematic data about the ways in which computing is being integrated into public life in the USA.[65] In the absence of systematic and high quality data, we must often rely upon scattered reports and a priori models.

The analyses presented here suggest that *laissez-faire* EFT developments best serve private enterprise and statist values. Furthermore, in schools, instructional computing best supports vocational matching. Conversely, EFT developments will not serve neo-populist or libertarian interests without special legal and institutional supports. Similarly, instructional computing in US schools is unlikely to serve egalitarian values very well without special institutional support. In short, *laissez-faire* computing best serves relatively powerful interests. At this time, both EFT developments and instructional computing are in their infancy in the USA. There are still many open social choices.[66]

Value conflicts in computing in Brazil

The values supported by computing developments are a significant part of their social meanings. Thus, the meanings of EFT systems are not simply their functional utility, but also the extent to which they support

[63] Evans, *op cit*, Ref 7.
[64] Rob Kling and Kenneth Kraemer, 'Computers and urban services', in Danziger *et al*, *op cit*, Ref 1.
[65] Kling, *op cit*, Ref 21.
[66] For a related analysis which examines value-conflicts in export controls over computing technologies in the USA, see Seymour Goodman, 'US export control policy: value conflicts and policy choices', *Communications of the ACM*, Vol 25, No 9, September 1982, pp 613–624.

social arrangements which facilitate entrepreneurial activity, strengthen or erode the extent to which people understand and control their financial transactions, etc. But the meaning of different named values will vary across cultures. In the USA, for example, consumers have had significantly more legal protection in defining fair trade practices than in many other countries.

The published literature about computing developments pays little explicit attention to important variations of culture and economy.[67] This section briefly examines how the value conflicts salient in debates about alternative computing developments in the USA can differ in another kind of economy: that of a developing country. Compared with other developing countries, Brazil is relatively large, rich in natural resources, urbanized and also has developed its own minicomputer industry. Compared with a developed country, such as the United States, its population is more rural, less literate and poverty is substantially more widespread. Moreover, in Brazil, the economic system is substantially more stratified: income distribution is more highly skewed;[68] a smaller set of wealthy elite groups control large rural farms and key urban enterprises. In addition, the federal government controls a larger fraction of the Brazilian economy (perhaps 60%), and there are a significant array of government-owned enterprises whose counterparts in the USA are private firms.

The Brazilian computer industry is anchored in seven major manufacturers of minicomputers and microcomputers. Strict trade controls protect these firms from international competition in machines of the size they manufacture. (Organizations seeking to import larger machines must receive approval from the Brazilian government.) Most computer applications are information systems which are tied to the internal operations of larger firms and public agencies.[69] In contrast with the USA, there are fewer applications with which the public has direct contact. Airline reservations are automated, but a significantly smaller fraction of the Brazilian population can afford to fly. There are relatively few large supermarkets and no supermarket scanners. Some large urban banks have online terminal systems for maintaining information about accounts, but there are no ATM machines. Credit cards are easily used in the cosmopolitan economies of the major cities, but are owned by a relatively smaller fraction of Brazilians. A few schools have microcomputers, but nationwide there is a shortage of classroom space for several million children. Most students, disproportionately from poor families, leave school by the end of the sixth grade.[70]

In Brazil, the main debates about computerization focus on supply side issues – how to obtain a larger number of more powerful machines at lower prices; how to develop better quality software locally; how to develop a larger pool of trained specialists who can work with and around computing. There is relatively little public discussion of the consumption side of computing. As a consequence, most computing developments are shaped by interests along in consonance with private enterprise[71] or statist values. Organizations which automate in accord with these values do not always have an easy time because of the structural mismatches between the requirements of computerization and the kinds of labour skills most easily available in Brazil. Moreover, many Brazilians depend upon the US computer industry information sources for information about the values of problems of computerization. These sources notoriously overestimate expected pay-offs and underestimate the social demands, costs, and practical difficulties of computerization.[72]

[67] Kalman, *op cit*, Ref 6.

[68] Werner Baer, *The Brazilian Economy: Its Growth and Development*, Grid Publishing, Columbus, OH, 1979; Sylvia Ann Hewlett, *The Cruel Dilemmas of Development: Twentieth Century Brazil*, Basic Books, New York, 1980.

[69] These applications are also relatively more costly in terms of aggregate social investment since the skills on which the operations of these systems hinge are significantly more scarce in Brazil than in the USA. Computer specialists are not the only scarce resource. Highly literate clerks for data entry jobs are drawn from a small fraction of the Brazilian population which has completed high school; these skills are much more common in the USA.

[70] Richard Weisskoff and Francine Weisskoff, 'The political economy of the educational system', in H. John Rosenbaum and William G. Tyler, eds, *Contemporary Brazil: Issues in Economic and Political Development*, Praeger, New York, 1972.

[71] Private firms are treated differentially: public policies favour national computer firms over multinational vendors even though local hardware prices are 2–3 times those of equivalent machines in the USA.

[72] Kling, *op cit*, Ref 21; Kling and Scacchi, *op cit*, Ref 46.

In addition, the political culture of Brazil[73] is quite different from that of the USA. In our value positions, the links between computerized record-keeping and individual political activity is anchored in libertarian arguments about protection of personal privacy. These protections are held to be especially important in countries with pluralist political systems in which politically unpopular groups are legitimate, but in which there have been periods of political repression aided by selected public agencies.

In Brazil, a strong military regime has maintained political control since 1965. During the 1960s and early 1970s, significant political opposition to the incumbent regime was illegal. Politically active people were sometimes harassed, imprisoned or executed. There has been a significant opening of the political arrangements during the last 4 years; multiple parties now flourish and the incumbent regime lost a significant set of political offices in a series of elections in November 1982. However, the more repressive period of Brazil's recent political history is the kind of political culture feared by libertarian analysts in the USA. Computerized files played a minor role in the degree and incidence of political repression because relatively common and highly visible forms of political activity were *de facto* illegal between the mid 1960s and late 1970s. After all, if organizing a new political party is illegal, one need not use subtle data systems to identify people who are relatively open in their attempts to recruit new members. Moreover, if one is attempting to organize a peasants' league, the potential recruits are drawn from the poorer segments of Brazilian society. Even if dues are not secret, members are not going to be paid by cheque or credit card. Members are more easily identified through informers than through computerized financial records. These contrasts between the United States and Brazil must be borne in mind when interpreting the meaning of value conflicts catalysed by computing developments in the two countries.

In both funds transfers and schooling, computerized technologies are much scarcer in Brazil than in the USA. If and when major EFT arrangements are developed in Brazil, private enterprise and statist values are most likely to dominate their design and deployment. Schooling quality and educational resources are also highly stratified in Brazil. While employment levels are relatively high, there has been substantial migration from rural areas to the six major cities during the last 20 years by workers seeking better kinds of jobs (and services). Many Brazilians view computer-related jobs as 'superb' jobs, and concerns about the stratification inherent in vocational matching arguments are less problematic for many Brazilians. There are strong egalitarian advocates in Brazil. But the disparities in social and educational resources between various regions, between various social classes, and between urban and rural districts is sufficiently large that alterations in the distribution of educational computing would play no significant role in redressing these major imbalances.

In summary, in developed countries value conflicts catalysed by computing developments are more complex than in developing countries. First, computing applications may be used by a large fraction of the population and consequently is a kind of social resource where access does not rigidly mirror stratification of wealth. In contrast, in a developing country like Brazil, most modes of computerization will be most highly accessible to a small urban elite and largely unavailable to the large groups of urban poor or rural populations in the next two decades. As a

[73]Most of these contrasts between the USA and Brazil are related to economic differences of a kind which are common to developed or developing countries. However, political cultures are more varied. For example, other developing countries such as Mexico, have not experienced the kind of political repression that characterized Brazilian politics from 1965 through the mid-1970s. Nonetheless, there are interesting arguments that rapid growth for developing countries requires sharpening income disparities, and that these 'exploitive' conditions are likely to lead to political conflict and possibly to repressive regimes. See *The Cruel Dilemmas of Development: Twentieth Century Brazil*, Sylvia Ann Hewlett, Basic Books, New York, 1980.

consequence, arguments about the social values of computerization in developing countries are more closely anchored to analyses of the social values served by different kinds of income stratification. However, we have seen that the values served by different forms of instructional computing are also tied to social stratification in the USA more than the values served by EFT developments which are discretionary.

Second, supply-side issues are more emphasized (and generate more anxiety) in developing countries like Brazil than in developed countries like the USA. Consumption side values such as protections for consumers are less well developed generally, in developing countries, and thus are less salient in proposals for alternative forms of computerization.

Conclusions

This article has examined the way in which new forms of computerization can be developed along different lines reflecting important social values. Key value issues differ somewhat in the case of different computer-based technologies. They also differ substantially in developed and developing countries. The value conflicts catalysed by new computing developments are sometimes subtle, and their political dimensions are often more important in the long run than in the short run. Many small decisions and commitments accumulate and alter the political economy of choice in many social arenas.

There are instructive parallels in the kinds of value conflicts which may be catalysed by computing developments in developed and developing countries. We know relatively little about the social changes, desired or not, which accompany computerization.[74] If the analyses developed here are valid for many other kinds of computing technologies, computing developments will often exacerbate social inequities unless disadvantaged groups are given special support. These inequities may be economic, as in the case of instructional computing in the USA or computing developments more generally in Brazil. They may be largely social and political as in the case of EFT developments. These inequities hinge as much upon access to collateral social resources – laws and practices to protect consumers in the case of EFT, access to skilled teachers in the case of instructional computing – as they do upon access to computing equipment. Socially sensitive proposals for computerization should take explicit account of the values sacrificed or compromised as well as those fostered by new forms of computerization.[75]

[74]Kling, *op cit*, Ref 21.

[75]For example, see Rob Kling, 'Accounting for social impacts in the design and development of computer-based information systems', in Harry Otway and Malcom Peltu, eds, *New Office Technology*, Francis Pinter, London (in press); see also Kling, *et al*, *op cit*, Ref 5.